Bent Core Nematics

Alignment and Electro-Optic Effects

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ABSTRACT

A new class of liquid crystal materials has been recently discovered. These materials are constituting of bent core (BC) molecules. Being initially only of scientific interest, now they attract the interest not only of scientists but also of engineers because of their great potential for applications in liquid crystal displays (LCDs) and photonics devices.

The present study focused mainly on pure BC nematics and their binary mixtures (BC/RL) with a rod-like (RL) nematic related to their

a) anchoring properties with respect to a solid surface in contact with these materials

b) general behavior under an applied dc electric field, and particular electro-optic response due to the linear coupling with the applied field

c) polar electro-optic response due to flexoelectricity.

The conventional methods for obtaining vertical alignment (VA) of the RL nematics were unable to promote VA of the BC and their binary (BC/RL) mixtures, for the concentration less than 20wt%, instead they adopted planar alignment (PA).

In concentration higher than 20wt%, the binary mixtures adopted VA in a very narrow temperature interval below the transition to the isotropic phase; where anchoring transition from VA to PA was observed upon cooling.

Interestingly, field-induced optically isotropic state and switching of the sample optic axis between three mutually orthogonal directions were observed in BC and BC/RL, with concentration less than 40wt%. Due to the similarity in the molecular structures, the above observations were compared with the one observed in anti-ferroelectric liquid crystals (AFLC) with molecular tilt close or equal to 45°.

Periodic domain pattern and helical molecular order, with helix axis parallel to the cell substrate and normal to the domains, were found to be formed under an applied dc electric field, as a result of flexoelectricity of the BC materials. Polar flexoelectric response was detected in these materials when subjected to an out-of plane or in-plane low frequency electric field.

Keywords: Liquid Crystal, Nematics, Bent Core Molecules, Electro-Optics, Biaxial, Flexoelectricity